



# Adverse Effects of COVID-19 and Face Masks: A Systematic Review

## ABSTRACT

**Background:** Due to the public health risk associated with SARS-CoV-2 (COVID-19) infection, universal use of face masks has been recommended to protect against viral spread. Adverse facial reactions from the utilization of masks in the general public are poorly characterized in literature. **Objective:** We aimed to provide a systematic review of studies reporting adverse facial reactions associated with use of face masks during the COVID-19 pandemic. **Methods:** PubMed and Cochrane databases were searched using the following search terms: "masks" AND "skin reactions, facial dermatosis, rash, acne, atopic dermatitis, rosacea, OR seborrheic dermatitis." **Results:** A total of 954 cases of dermatological adverse effects were reported. Over 17 different adverse facial reactions were found, including the top 10 in order: itch (370, 38.8%), indentation/ear pain (102, 10.7%), discomfort (90, 9.4%), erythema (72, 7.5%), dryness (62, 6.5%), rash (60, 6.3%), scarring (42, 4.4%), desquamation (22, 2.3%), pain (19, 2.0%), burning (19, 2.0%), and wheals (7, 0.7%). Face masks can increase acne (n=44), rosacea (n=14), and seborrheic dermatitis (n=9). **Limitations:** Publication bias of articles, with limited studies available regarding this topic. **Conclusion:** Wearing face masks to protect from COVID-19 can increase adverse facial dermatoses and exacerbate underlying dermatology conditions; however, several preventative measures may be taken.

**KEYWORDS:** COVID-19, facial dermatosis, viral infections, atopic dermatitis, acne, seborrheic dermatitis, rosacea, N95

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Emerging in December 2019, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) resulted in the global pandemic known as COVID-19. COVID-19 has serious concerns for morbidity and mortality; thus, face masks have been recommended for universal use in the prevention of COVID-19 aerosol spread.<sup>1,2</sup> Surgical face masks and N95 masks were previously shown to be effective against influenza, tuberculosis, and SARS in Hong Kong.<sup>3</sup> Recently, with a global shortage of N95 and surgical masks, the Centers for Disease Control and Prevention (CDC) recommended that healthy individuals substitute cloth masks for use in public.<sup>4</sup>

However, increased utilization of face masks to reduce spread of the viral illness has been associated with numerous facial dermatoses and adverse reactions. This phenomenon is poorly characterized in literature.<sup>5,6</sup> As the prevalence of facial skin reactions and exacerbation of underlying skin conditions in the general population and healthcare workers increases, clinicians should maintain vigilance in detecting, monitoring, and helping treat adverse effects of face masks. The goal of our systematic review is to summarize the results of studies that report adverse facial skin reactions resulting from the use of face masks during the COVID-19 pandemic.

## METHODS

Our systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses. PubMed and Cochrane databases were queried on October 20, 2020 using the following search terms: "masks" AND "skin reactions, facial dermatosis, rash, acne, atopic dermatitis, rosacea, OR seborrheic dermatitis." Articles written in English that were published in the last 10 years were included. Systematic reviews with or without meta-analyses, narrative reviews, and articles with irretrievable records were excluded. After screening abstracts and completing full-text review, only articles pertaining to mask use during COVID-19 and adverse skin reactions were extracted and analyzed (Table 1).

## RESULTS

**Study selection.** After removal of duplicates, the search yielded 401 results. Initial screening of text was performed by reviewing article titles and abstracts. Nineteen articles were included for full-text review; 16 articles were excluded after full-text review. While examining bibliography sections during full-text review, four additional records were added. A total of seven studies were included in this review. The studies include three case

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**TABLE 1.** Reported adverse events of face masks utilized during COVID-19

AUTHOR, YEAR (COUNTRY)	STUDY DESIGN (LEVEL OF EVIDENCE)	DEMOGRAPHICS	FACIAL SKIN REACTION, N (%) AND AREAS AFFECTED	UNDERLYING FACIAL CONDITION	MASK TYPE, N (%)	DURATION	TREATMENT (%)
Szepietowski et al, <sup>7</sup> 2020 (Poland)	Cross-sectional questionnaire study (4)	N=2,307 (1,393 face mask users); age: 20.2±1.7 years (age range: 18–27 years); female: n=1,861 (80.7%); male: n=446 (19.3%); students and young people	Itch: 273 (19.6); tingling: 102 (37.4); burning: 72 (26.3); pinching: 50 (18.3); tingling: 25 (9.1);  Areas affected: no details	<ul style="list-style-type: none"> <li>Sensitive skin: OR=3.4029 (2.4706, 4.6870; <math>p&lt;0.0001</math>)</li> <li>Atopic predisposition: OR=2.2536 (1.7234, 2.9469; <math>p&lt;0.001</math>)</li> <li>Atopic dermatitis: OR=1.9248 (1.3485, 2.7473; <math>p=0.0003</math>)</li> <li>Acne: OR=1.2947 (1.1285, 1.4854; <math>p=0.0002</math>)</li> <li>Seborrheic dermatitis: OR=1.2969 (1.1125, 1.5117; <math>p=0.0009</math>)</li> </ul>	Three-layer surgical masks: 755 (54.2); cloth masks: 891 (64.0); respirators (N95): 257 (18.4); half-face elastomeric respirators: 16 (1.1); full-face respirators: 8 (0.4)	≤1 hour ( $p<0.001$ ); ≤2 hours: ( $p<0.0001$ ); ≤3 hours: ( $p<0.0001$ ); >5 hours: ( $p<0.001$ )*	Emollients (53.2); water (23.7); oral antihistamines (15.9); topical recommendations by pharmacists/doctors (6.5); ice pack (0.7)
Hua et al, <sup>11</sup> 2020 (China)	Randomized crossover design with repeated measures (1b)	N=20; age: 34.3±11.5 years; female: n=18 (90%); male: n=2 (10); healthy volunteers	Redness or erythema: N95=17 (85), medical mask=3 (15), $p<0.001$ ; facial indentation: N95=19 (95), medical mask=0 (0), $p<0.001$ ; itch: N95=12 (60), medical mask=7 (35), $p=0.21$ ; pain or prickling: N95=6 (30), medical mask=0 (0), $p=0.02$ ; burning: N95=3 (15), medical mask=1 (5), $p=0.61$  Areas affected: facial skin, respiratory tract, eyes	No details	N95 masks and medical masks	2 and 4 hours	No details
Hu et al, <sup>16</sup> 2020 (China)	Cross-sectional questionnaire study (4)	N=61; female: 56 (91.8); male: 5 (8.2); physicians and nurses	Nasal bridge scarring: 42 (68.9); facial itch: 17 (27.9); skin damage: 16 (26.2); dry skin: 15 (24.6); rash: 10 (16.4); wheals: 7 (11.5); indentation and ear pain: 7 (11.5); skin desquamation: 6 (9.9); acne: 1 (1.6)  Areas affected: no details	No details	N95 masks: had symptoms; surgical masks: no symptoms; cloth masks: no symptoms; paper masks: no symptoms	N95: 12 hours/day over a mean of 3.5 months	n=5: treatments from doctor; n=15: self-treatment; n=41: none
Xie et al <sup>34</sup> 2020(China)	Case report (4)	N=1; age: 23 years; female; no other details	Mask-induced allergic contact dermatitis: 1 (100); rythema: 1 (100); itch: 1 (100)  Areas affected: cheeks	No details	KN95 masks	2 days	Oral desloratadine and topical desonide cream

**TABLE 1.** Reported adverse events of face masks utilized during COVID-19, continued

AUTHOR, YEAR (COUNTRY)	STUDY DESIGN (LEVEL OF EVIDENCE)	DEMOGRAPHICS	FACIAL SKIN REACTION, N (%) AND AREA AFFECTED	UNDERLYING FACIAL CONDITION	MASK TYPE, N (%)	DURATION	TREATMENT (%)
Aerts et al, <sup>8</sup> 2020 (Belgium)	Case report (4)	N=1; age: 38 years; female; nurse	Allergic contact dermatitis: 1 (100) Areas affected: cheeks	Erythematous and telangiectatic rosacea	N95 masks	Few hours	No details
Mutalik et al, <sup>9</sup> 2020 (India)	Case report (4)	N=1; age: 74 years; male; no other details	Köebner reaction: 1 (100) Areas affected: scalp=1 (100), supra-auricular=1 (100)	Psoriasis	Ear-looped mask	No details	Topical corticosteroids, avoidance of ear-looped mask
Zuo et al <sup>10</sup> 2020 (China)	Cross-sectional questionnaire study (4)	N=404; age: no details; female : n=304 (75.2); male: n=100 (24.8); healthcare workers	Acne exacerbation: 44 (10.9); seborrheic dermatitis exacerbation: 9 (2.2); rosacea exacerbation: 14 (3.5); allergic dermatitis exacerbation: 1 (0.3); eczema exacerbation: 1 (0.3); unexplained facial dermatitis exacerbation: 1 (0.3); folliculitis exacerbation: 1 (0.3); discomforts caused by mask straps: 90 (22.3); facial indentation: 76 (18.8); itch: 60 (14.9); redness or erythema: 51 (12.6); rash: 50 (12.4); dry or desquamated skin: 47 (11.6); burning: 15 (3.7); pain or prickling: 13 (3.2); swelling: 5 (1.2); numbness: 5 (1.2); greasy skin: 4 (1.0)  Areas affected: facial skin=169 (85.4); respiratory tract=69 (17.1); eye=25 (6.2)	Acne: n=101; seborrheic dermatitis: n=26; rosacea: n=14; allergic dermatitis: n=3; eczema: n=2; unexplained facial dermatitis: n=2; folliculitis: n=1	Medical masks: 366 (90.6); N95 masks: 38 (9.4)	<4 hours: n=174 (43.1%); 4–8 hours: n=146 (36.1%); >8 hours: n=84 (20.8%)	No details

OR: Odds ratio

\*p-values compared duration of mask usage associated with itch

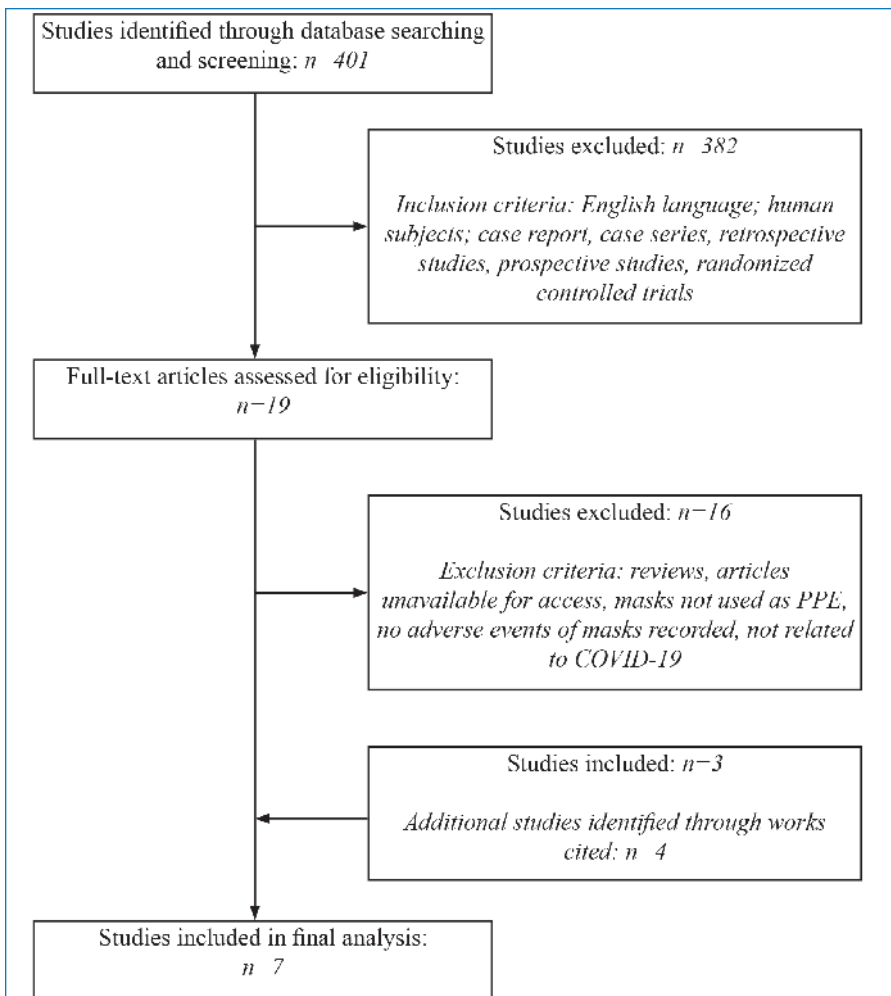
reports, one randomized clinical trial, and three cross-sectional studies. The selection process of the articles and ranking of the studies by the Oxford Centre for Evidence-Based Medicine are summarized in Figure 1 and Table 1.

**Overall results.** A total of 954 cases of dermatological adverse effects were reported as a result of face masks. Out of these, 881 were reported in cross-sectional studies,

68 were reported in a randomized clinical trial, and five were from independent case reports. Over 17 unique skin reactions were reported. A total of 2,795 individuals were included in the seven articles. This consisted of a total of 554 males and 2,241 females. Numerous studies did not categorize the type of participant involved, but many of the study subjects were physicians, nurses, additional healthcare workers, youth/students, and other

healthy volunteers. The most common types of face masks utilized in the studies included N95 masks, KN95 masks, surgical masks, and cloth masks. One cross-sectional study also discussed use of half-face elastomeric respirators and full-face respirators.

**Skin reaction.** Numerous adverse facial skin reactions following mask use were reported. The 10 most common reactions were itch (n=370, 38.8%), facial indentation/



**FIGURE 1.** Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram

ear pain ( $n=102$ , 10.7%), discomfort ( $n=90$ , 9.4%), redness or erythema ( $n=72$ , 7.5%), dryness ( $n=62$ , 6.5%), rash ( $n=60$ , 6.3%), scarring ( $n=42$ , 4.4%), desquamation ( $n=22$ , 2.3%), pain ( $n=19$ , 2.0%), and burning ( $n=19$ , 2.50%) (Table 2). Furthermore, a total of five studies reported itch, with prevalence rates ranging from 14.9 to 60.0 percent, while three studies reported indentation (with or without ear pain) in 11.5 to 95 percent of participants. Redness or erythema was also frequently reported, with prevalence rates ranging from 11.5 to 95 percent in three studies. Burning was also noted, with two studies reporting prevalence rates ranging from 11.6 to 24.6 percent. Acne was less common, but still notable, with four studies reporting prevalence rates ranging from 1.6 to 10.9 percent. The most commonly reported

skin condition exacerbations included acne ( $n=44$ , 4.6%), rosacea ( $n=14$ , 1.5%), seborrheic dermatitis ( $n=9$ , 0.9%), allergic dermatitis ( $n=1$ , 0.1%), eczema ( $n=1$ , 0.1%), unexplained facial dermatitis ( $n=1$ , 0.1%), and folliculitis ( $n=1$ , 0.1%) (Table 2).

**Underlying skin conditions.** Four studies explored the role of previous skin disorders in the development of adverse skin reactions associated with wearing masks.<sup>7–10</sup> We identified 11 unique underlying skin conditions reported by subjects, which included sensitive skin, atopic predisposition, atopic dermatitis, acne, seborrheic dermatitis, rosacea, psoriasis, allergic dermatitis, eczema, facial dermatitis, and folliculitis. Rosacea and seborrheic dermatitis were reported in two studies. Szepietowski et al reported an increased risk of adverse skin reactions with

mask use for individuals with sensitive skin (OR: 3.40, 95% CI: 2.47–4.69), atopic predisposition (OR: 2.25, 95% CI: 1.72–2.95), atopic dermatitis (OR: 1.92, 95% CI: 1.35–2.75), acne (OR: 1.29, 95% CI: 1.13–1.49), or seborrheic dermatitis (OR: 1.30, 95% CI: 1.11–1.51).<sup>7</sup> Zuo et al's study reported exacerbation of all underlying skin conditions that were reported, including acne, seborrheic dermatitis, rosacea, and allergic dermatitis.<sup>10</sup> Interestingly, Mutalik et al described one patient with a history of psoriasis who experienced the Koebner phenomenon as a result of wearing an ear-looped mask.<sup>9</sup>

**Mask type.** The use of N95 and KN95 masks, the most commonly utilized face masks, was reported in six studies. Surgical/medical masks were utilized in four of the studies, while cloth masks were used in two studies. Other masks mentioned by single studies include half-face elastomeric respirators, full-face respirators, paper masks, and ear-looped masks. A randomized crossover design study reported significantly more erythema ( $p<0.001$ ), facial indentation ( $p<0.001$ ), and pain ( $p=0.02$ ) with N95 masks compared to medical masks.<sup>11</sup>

**Area affected.** Locations of adverse skin facial reactions were reported in 71.4 percent of the studies. The most commonly affected areas of the face included facial skin/unspecified, respiratory tract, eyes, cheeks, scalp, and supra-auricular.

**Length of mask usage.** In studies analyzing length of usage, adverse facial reactions were significantly associated with time duration of mask utilization. A study of multiple mask types from Szepietowski et al found significant associations between length of mask usage and adverse reactions.<sup>7</sup>

## DISCUSSION

Our study reveals numerous facial dermatoses and adverse reactions that might have been provoked by face masks in the COVID-19 era. This study aimed to summarize the limited data available regarding various skin conditions and adverse reactions that resulted from wearing masks by the general population during the COVID-19 pandemic. We also aimed to uniquely categorize risk factors for development of skin reactions with mask type, length of usage, and area affected.

Overall, female subjects had higher representation than male subjects in studies investigating the dermatological adverse

events associated with face masks. Among affected healthcare workers, there was a preponderance for nurses and doctors suffering adverse events compared to other hospital staff in studies with available information. Patient age ranged from 18 to 74 years old, with the majority of the studies being conducted in China. Increased length of wearing face masks was found to have a strong association with adverse facial dermatosis.<sup>7</sup> Our results are in accordance with Foo et al's study, reporting high rates of adverse skin reactions with personal protective equipment (PPE) usage during the severe acute respiratory distress syndrome in the 2000s.<sup>5</sup>

Prolonged usage of face masks can cause superficial maceration and damage the skin barrier.<sup>12</sup> Increased pressure on anatomic points, such as the nasal bridge and the zygoma, can cause friction-related damage.<sup>13,14</sup> Combined factors, such as prolonged usage, pressure, and lack of proper cleaning, can also exacerbate underlying skin conditions and potentially spread bacteria.<sup>14</sup> Face masks, especially N95 masks, create a tight environment for protection, along with a warm and moist environment under the mask, where skin microbial populations associated with facial dermatosis can enhance adverse reactions.<sup>10</sup> Hua et al's study also found that increased temperature, moisture created by local expiration, and friction adversely affected the skin barrier and antimicrobial defense.<sup>11</sup> Wearing face masks was shown to cause increased sebum production in areas without the face mask contact as well.<sup>11</sup> Similarly, studies have hypothesized that occlusion of the pilosebaceous unit from tight face masks can induce acne flares.<sup>6</sup> Facial skin reactions and exacerbation of skin conditions can also be secondary to formaldehyde, polypropylene, and additional preservatives found in masks. Moreover, masks can contain rubber straps, glue, or metal clips that could induce irritant or allergic contact dermatitis.<sup>5,15–17</sup> All of these factors combined can induce inflammatory facial dermatoses and adverse reactions. Patients suffering reactions to face masks might become non-compliant with face mask mandates, leading to spread of COVID-19 and other respiratory illnesses.

Compared to other face masks, N95 masks were most likely to cause adverse facial reactions. N95 masks were also reported

to cause higher levels of discomfort and nonadherence, possibly due to pressure-related symptoms.<sup>10</sup> Furthermore, Zuo et al stated that N95 masks have the least air permeability and cause greater pressure than other mask types, potentially increasing the number of adverse skin reactions. The study stated commonly reported facial reactions included acne, itch, and rashes, which were associated with usage of N95 masks.<sup>10</sup>

Several recommendations for the treatment of adverse facial reactions from masks exist. Users should wash their face with a gentle, oil-free, fragrance-free cleanser every morning and night.<sup>14</sup> Noncomedogenic facial moisturizers and gels are recommended one hour before utilizing face masks.<sup>14</sup> Additionally, proper cleansing, including hand washing with water and soap or hand sanitizing, prior to wearing and removing the mask is recommended.<sup>18</sup> To avoid adverse reactions from face masks, healthcare workers can also gently adjust and tighten the mask's metal clip on the bridge of the nose to maintain a proper fit.<sup>16</sup> Additionally, alcohol-free barriers or thin foam dressings in areas of direct PPE contact or behind ear loops of surgical masks can decrease the risk of pressure induced injuries and reduce skin irritation.<sup>14,19–21</sup> Multiple dressings should be avoided, as they can contribute to increased pressure.<sup>19</sup> Petroleum-based products can affect mask effectiveness and thus their use is not recommended with face masks.<sup>14</sup> Skin protectants and dressings should be utilized with caution, due to potential alterations in N95 mask fit and efficacy.<sup>22</sup> Intermittent breaks from masks, for 15 minutes every two hours while in a safe environment, are recommended.<sup>14</sup> In areas of skin damage, hydrophobic compresses with normal saline, zinc ointment, or cream may be used.<sup>15</sup> In patients with underlying acne, topical retinoids and systemic antibiotics have shown effectiveness.<sup>6</sup>

To achieve sufficient protection against COVID-19, we recommend a combination of physical distancing (1m minimum, 2m recommended), eye protection, proper hand hygiene, and multilayered face masks (multilayer cloth mask over surgical mask).<sup>23,24</sup> Although N95 masks can cause increased facial reactions, this mask type is associated with the largest reduction in infection risk compared to surgical or cotton masks ( $p=0.090$ ).<sup>11,23,25</sup>

**TABLE 2.** Reported facial skin reactions associated with COVID-19 face masks

ADVERSE SKIN REACTION, N=954	n (%)
Itch	370 (38.8)
Indentation/ear pain	102 (10.7)
Discomfort	90 (9.4)
Redness or erythema	72 (7.5)
Dryness	62 (6.5)
Rash	60 (6.3)
Scarring	42 (4.4)
Desquamation <sup>a</sup>	22 (2.3)
Pain <sup>b</sup>	19 (2.0)
Burning	19 (2.0)
Wheals	7 (0.7)
Numbness	5 (0.5)
Swelling	5 (0.5)
Greasy skin	4 (0.04)
Allergic contact dermatitis	2 (0.2)
Acne	1 (0.1)
Koebner phenomenon	1 (0.1)
Skin condition exacerbation	
Acne exacerbation	44 (4.6)
Rosacea exacerbation	14 (1.5)
Seborrheic dermatitis exacerbation	9 (0.9)
Allergic dermatitis exacerbation	1 (0.1)
Eczema exacerbation	1 (0.1)
Unexplained facial dermatitis exacerbation	1 (0.1)
Folliculitis exacerbation	1 (0.1)
No.: number	
<sup>a</sup> includes damage	
<sup>b</sup> includes pinching, prickling, and stinging	

The effectiveness of N95 masks is due to their ability to filter more than 95 percent of airborne pathogens.<sup>25</sup> N95 masks effectively reduce transmission of particles greater than 300nm in size.<sup>25</sup> While SARS-CoV-2 particles are 80 to 120nm in size, particles covered with human saliva increase in size, allowing effective prevention of the virus when released into the air.<sup>16</sup> When N95 mask availability increases, we recommend usage of N95 masks with skin protectants and N95 mask retesting for healthcare workers and the general public. The N95 mask fit rechecking allows for a proper fit in order to maintain efficacy in preventing viral transmission and



avoid development of facial conditions.<sup>22,25,26</sup> Surgical masks, have been shown to be non-inferior when combined with additional PPE measures, and thus it is recommended that the general public use these in low-risk exposure settings.<sup>26,27</sup> Furthermore, N95 masks can be decontaminated with ultraviolet germicidal irradiation at 254nm before reuse.<sup>27</sup> Studies reported utilizing N95 masks for greater than four hours had a nonsignificant association ( $p=0.053$ ) with hypoxia and hypercapnia, which can lead to headaches and chest discomfort.<sup>28,29</sup> The CDC does not recommend combining N95 masks with any other mask type.<sup>24</sup> However, the CDC does recommend using a multilayer cloth mask with a medical mask (or any mask with nose wire) and folding of edges with proper coverage over nose, mouth, and chin to reduce virus transmission.<sup>24,30</sup> Even with the development of a COVID-19 vaccine, there is currently no approved treatment regimen to prevent the spread of COVID-19.<sup>31</sup> As the vaccine is recently FDA-approved and released for usage, we continue to recommend mask usage and social distancing for added protection.<sup>32,33</sup>

**Limitations.** Some limitations can be noted for this study. Due to the recent emergence of COVID-19, we were only able to search databases covering a short time period. As a result of limited available studies, adverse dermatology effects of face masks may be under-reported. For example, with time, more studies may be conducted regarding adverse skin reactions, allowing a better understanding of the long-term effects and breadth of possible skin reactions. Another limitation is the heterogeneous nature of reporting results. Details of the adverse events and measurements of skin reactions were lacking, causing an underestimation of the severity and full scope of effects. Additionally, numerous studies did not quantitatively report the number of patients affected by skin reactions; thus, categorization of these events and reports remain challenging. Finally, our study was limited to two databases, affecting the number of studies categorized in this report.

As our study only focused on the dermatologic effects and adverse cutaneous reactions of face masks, we did not investigate reactions to other forms of PPE (e.g., gloves, gowns, and googles). Furthermore, systemic

effects of face masks were not included in our study. Our study uniquely analyzes existing literature on adverse facial reactions to masks from COVID-19 in the general population. Notwithstanding study limitations, this review may serve as a guide for further studies to confirm the effects of masks on skin barriers as well as the pathophysiology of increased skin reactions.

## CONCLUSION

Increasing prevalence of adverse skin reactions and exacerbation of underlying skin conditions has resulted from greater utilization of face masks. As an essential and fundamental measure to reduce the transmission and spread of COVID-19, we recommend full compliance with mask mandates and support the usage of face masks. Our systematic review evaluated the role of masks and adverse facial reactions in the general population. We examined this relationship and categorized many adverse effects to face masks in numerous roles, from students to healthcare workers. Furthermore, to prevent adverse events of face masks and exacerbation of underlying skin conditions, we recommend preventative and treatment measures to avoid development of skin reactions.

## REFERENCES

- Liu Y, Leachman SA, Bar A. Proposed approach for reusing surgical masks in COVID-19 pandemic. *J Am Acad Dermatol*. 2020;83(1):e53–e54.
- Esposito S, Principi N, Leung CC, Migliori GB. Universal use of face masks for success against COVID-19: evidence and implications for prevention policies. *Eur Respir J*. 2020;55(6):2001260.
- Offeddu V, Yung CF, Low MSF, Tam CC. Effectiveness of masks and respirators against respiratory infections in healthcare workers: a systematic review and meta-analysis. *Clin Infect Dis*. 2017;65(11):1934–1942.
- Centers for Disease Control and Prevention. How to protect yourself and others. 2020. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html>. Accessed 2020 Oct 28.
- Foo CCI, Goon ATJ, Leow Y-H, Goh C-L. Adverse skin reactions to personal protective equipment against severe acute respiratory syndrome—a descriptive study in Singapore. *Contact Dermatitis*. 2006;55(5):291–294.
- Tan KT, Greaves MW. N95 acne. *Int J Dermatol*. 2004;43(7):522–523.
- Szepietowski JC, Matusiak Ł, Szepietowska M, et al. Face mask-induced itch: a self-questionnaire study of 2,315 responders during the COVID-19 pandemic. *Acta Derm Venereol*. 2020;100(10):adv00152.
- Aerts O, Dendooven E, Foubert K, et al. Surgical mask dermatitis caused by formaldehyde (releasers) during the COVID-19 pandemic. *Contact Dermatitis*. 2020;83(2):172–173.
- Mutalik SD, Inamdar AC. Mask-induced psoriasis lesions as Köbner phenomenon during COVID-19 pandemic. *Dermatol Ther*. 2020.
- Zuo Y, Hua W, Luo Y, Li L. Skin reactions of N95 masks and medial masks among health-care personnel: a self-report questionnaire survey in China. *Contact Dermatitis*. 2020;83(2):145–147.
- Hua W, Zuo Y, Wan R, et al. Short-term skin reactions following use of N95 respirators and medical masks. *Contact Dermatitis*. 2020;83(2):115–121.
- Lan J, Song Z, Miao X, et al. Skin damage among health care workers managing coronavirus disease-2019. *J Am Acad Dermatol*. 2020;82(5):1215–1216.
- Oranges T, Janowska A, Dini V. Reply to: "Skin damage among health care workers managing coronavirus disease-2019." *J Am Acad Dermatol*. 2020;82(6):e233–e234.
- Desai SR, Kovarik C, Brod B, et al. COVID-19 and personal protective equipment: treatment and prevention of skin conditions related to the occupational use of personal protective equipment. *J Am Acad Dermatol*. 2020;83(2):675–677.
- Maliyar K, Sachdeva M, Mufti A, Yeung J. Reply to: "Skin damage among health care workers managing coronavirus disease 2019." *J Am Acad Dermatol*. 2020;83(2):e169–e170.
- Hu K, Fan J, Li X, et al. The adverse skin reactions of health care workers using personal protective equipment for COVID-19. *Medicine (Baltimore)*. 2020;99(24):e20603.
- Yu J, Chen JK, Mowad CM, et al. Occupational dermatitis to facial personal protective equipment in healthcare workers: a systematic review. *J Am Acad Dermatol*. 2021;84(2):486–494.
- Desai AN, Mehrotra P. Medical masks. *JAMA*. 2020;323(15):1517–1518.
- National Pressure Injury Advisory Panel. NPIAP Position statements on preventing injury with N95 masks. 2020. Available from: [https://cdn.ymaws.com/npiap.com/resource/resmgr/position\\_statements/Mask\\_Position\\_Paper\\_FINAL\\_fo.pdf](https://cdn.ymaws.com/npiap.com/resource/resmgr/position_statements/Mask_Position_Paper_FINAL_fo.pdf). Accessed 2020 Nov 18.
- European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel, and Pan Pacific Pressure Injury Alliance. Prevention and treatment of pressure ulcers/injuries: clinical practice guideline. Third ed: EPUAP-NPIAP-PPPIA. 2019.
- Pacis M, Azor-Ocampo A, Burnett E, et al. Prophylactic dressings for maintaining skin integrity of healthcare workers when using N95 respirators while preventing contamination due to the novel coronavirus: a quality improvement project. *J Wound Ostomy Continence Nurs*. 2020;47(6):551–557.
- Bui A-TN, Yu Z, Lee K, et al. A pilot study of the impact of facial skin protectants on qualitative fit testing of N95 masks. *J Am Acad Dermatol*. 2021;84(2):554–556.
- Chu DK, Akl EA, Duda S, et al. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *Lancet*. 2020;395(10242):1973–87.
- Centers for Disease Control and Prevention. Improve

- how your mask protects you. 2021. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/your-health/effective-masks.html>. Accessed 2021 Feb 11.
25. Dugdale CM, Walensky RP. Filtration efficiency, effectiveness, and availability of N95 face masks for COVID-19 prevention. *JAMA Intern Med*. 2020;180(12):1612–1613.
26. US Food and Drug Administration. N95 respirators, surgical masks, and face masks. 2021. Available from: <https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/n95-respirators-surgical-masks-and-face-masks>. Accessed 2021 Feb 11.
27. Boškoski I, Gallo C, Wallace MB, Costamagna G. COVID-19 pandemic and personal protective equipment shortage: protective efficacy comparing masks and scientific methods for respirator reuse. *Gastrointest Endosc*. 2020;92(3):519–523.
28. Lim EC, Seet RC, Lee KH, et al. Headaches and the N95 face-mask amongst healthcare providers. *Acta Neurol Scand*. 2006;113(3):199–202.
29. Kao TW, Huang KC, Huang YL, et al. The physiological impact of wearing an N95 mask during hemodialysis as a precaution against SARS in patients with end-stage renal disease. *J Formos Med Assoc*. 2004;103(8):624–628.
30. Centers for Disease Control and Prevention. Maximizing fit for cloth and medical procedure masks to improve performance and reduce SARS-CoV-2 transmission and exposure, 2021. 2021. Available from: <https://www.cdc.gov/mmwr/volumes/70/wr/mm7007e1.htm>. Accessed 2021 Feb 10.
31. Centers for Disease Control and Prevention. Frequently asked questions about COVID-19 vaccination. 2020. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/faq.html>. Accessed 2020 Nov 26.
32. Centers for Disease Control and Prevention. Benefits of getting a COVID-19 vaccine. 2020. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/vaccine-benefits.html>. Accessed 2020 Nov 25.
33. US Food and Drug Administration. FDA takes key action in fight against COVID-19 by issuing emergency use authorization for first COVID-19 vaccine. 2020. Available from: <https://www.fda.gov/news-events/press-announcements/fda-takes-key-action-fight-against-covid-19-issuing-emergency-use-authorization-first-covid-19>. Accessed 2020 Dec 15.
34. Xie Z, Yang YX, Zhang H. Mask-induced contact dermatitis in handling COVID-19 outbreak. *Contact Dermatitis*. 2020;83(2):166–167. 